

A redescription of *Trochammina nana* (Brady) (Protozoa: Foraminiferida), with observations on several other Recent Trochamminidae in the Collections of the British Museum (Natural History)

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Introduction

As part of a major revision of the Trochamminidae from several parts of the world, in particular the waters of the South Atlantic (Brönnimann, 1976, 1979; Brönnimann & Beurlan, 1977, 1977a; Brönnimann & Whittaker, in preparation), the present authors have found it necessary to examine the important Recent foraminiferal Collections of H. B. Brady and Heron-Allen & Earland, housed in the British Museum (Natural History) (B.M.N.H.). In the Brady Collection, several of the trochamminids have been found to be in need of taxonomic revision, and this paper deals with the confusion surrounding *Haplophragmium nanum*.

Brady (1881 : 50) proposed for a small trochospiral agglutinated foraminifer collected by the *Challenger* Expedition, the name *Haplophragmium nanum*. At the time he did not specify the station(s) at which the new species occurred, and he described it, without illustration, as follows:

‘Test minute, rotaliform, depressed; superior face somewhat convex; inferior, plane, more or less excavated at the umbilicus; margin rounded, lobulate. Consists of about two revolutions, each composed of about six inflated segments, often irregular in shape and disposition. Shell texture thin, resembling that of *H. canariense*. Diameter. 1/75 inch (0·34 mm).’

H. nanum Brady is therefore a valid name according to Article 12 of the International Code of Zoological Nomenclature. The lack of illustration is however unfortunate in the light of the ensuing taxonomic disorder.

Subsequently, Brady (1881a) reported *H. nanum* from Arctic waters. This was material from the Austro-Hungarian North Polar Expedition and had been sent to Brady for identification by his friend Dr F. Karrer of Vienna. Brady's text was translated into German and apart from one or two mis-translations and an extra plate (pl. 1) showing the locations of the soundings in the vicinity of Franz-Josef Land and Novaya Zemlya, is identical to the English text; the German version was not however published until 1882.

Haplophragmium nanum is said by Brady (1881a: 406) to be . . . ‘the commonest of all the smaller arenaceous forms, over the whole area reported by these soundings . . .’. He also states that the Arctic specimens are . . . ‘rather smaller than those described from the *Challenger* dredgings [Brady, 1881] and seldom exceed 0·25 millim. in diameter; they are generally less convex on the superior surface and altogether somewhat thinner . . .’. The

accompanying illustration (Brady, 1881a, pl. 21, figs 1a–c) is apparently of a single specimen in spiral, edge and umbilical views, and is the first published figure. It must however be emphasized that this specimen was not from the *Challenger* material from which the original description was made.

In the *Challenger* Report, Brady (1884: 311, pl. 35, figs 6a–c, 7, 8) described *H. nanum* again in more detail, giving the locations of his figured specimens. That shown in plate 35, figs 6a–c appears at first glance to be identical to the specimen in plate 21, figs 1a–c of his 1881a paper, but on close examination can be seen to differ in several respects particularly in edge and umbilical views. Perhaps Brady had merely instructed his engraver, Mr Hollick, to make the previous illustration a little more accurate, or may have had drawn a completely different specimen. According to our records, the specimen shown in Brady, 1884, pl. 35, figs 6a–c, comes from a slide of about 40 individuals from the Austro–Hungarian North Polar Expedition station 518, off Franz-Josef Land (B.M.N.H. slide no. ZF 1546), at 113 fathoms (207 m), but it is not possible to ascertain with certainty which particular individual was figured. Brady did not himself designate holotypes nor in general give any indication as to which syntype(s) he illustrated. Nevertheless, this figured specimen is typical of the suite in ZF 1546. Figures 7, 8, of Brady's plate 35 were also attributed to *H. nanum* and came from *Challenger* station 346, north of Ascension Island in the South Atlantic (B.M.N.H. slide no. ZF 1547), at 2,350 fathoms (4,300 m). Two specimens were used for the engraving; only 8 syntypes now remain.

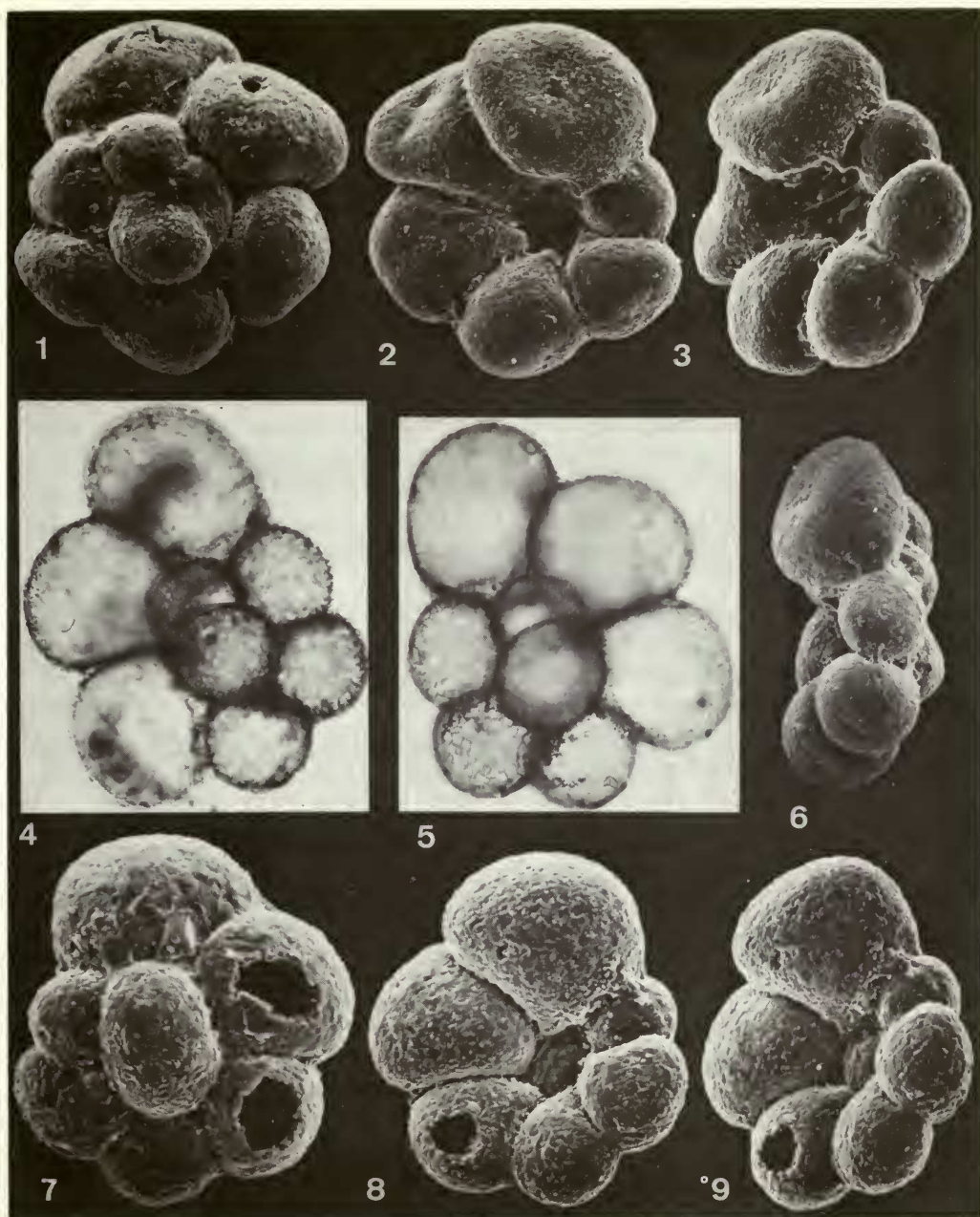
Brady (1884) was obviously of the opinion that the Arctic and South Atlantic forms were conspecific, but probably because he had seen many more specimens from the Austro–Hungarian North Polar Expedition dredgings than from the *Challenger*, he wrote that . . . (p. 312) . . . 'fig. 6 represents the typical form, while figs 7 and 8 are examples of irregularly grown tests'. Nevertheless, he felt it necessary to modify his original description to accommodate the Arctic forms . . .

'Test minute, Rotaliform, depressed; consisting of about two convolutions, the outermost of which is composed of six or seven somewhat inflated segments, often irregular in shape and disposition. Superior face flat or slightly convex; inferior face convex, more or less excavated at the umbilicus. Walls thin; texture resembling that of *Haplophragmium canariense*; colour light-brown, the final segment somewhat lighter than the rest. Diameter 1/75 inch (0.34 mm) or less.'

Subsequent workers (e.g. Barker, 1960) have always followed Brady (1884) and apart from referring it to *Trochammina*, have accepted this wide concept of the species without question. After studying the early literature on *H. nanum* outlined above, our growing apprehension that Brady had in fact confused two distinct species was confirmed on examining the respective syntypic slides in the Museum. It was also possible to produce scanning electron micrographs of several specimens from each slide and the results are illustrated in this paper. The two forms are shown not only to be separate species, but also to warrant separate generic status.

Haplophragmium nanum Brady must be based on the *Challenger* South Atlantic material from north of Ascension Island (Stn 346) as the first valid description (Brady, 1881) was made without reference to the Arctic collections (R. V. Melville, pers. comm.). The species is now redescribed and illustrated (Figs 1–9) as a *Trochammina* and a lectotype chosen. Specimens from the Austro–Hungarian North Polar Expedition stations, even though later stated by Brady (1884) to . . . 'represent the typical form . . .', must be given a new name; we propose *Portatrochammina bipolaris* sp. nov., as it has also been found to occur in Antarctic as well as Arctic waters (see Figs 15, 16, 18–31).

We have examined every one of the very many slides in the Collections labelled *Haplophragmium nanum* (or *Trochammina nana*), ranging in age from Cretaceous to Recent and from present day polar, temperate and tropical regions, in order to ascertain the true geographical and stratigraphical range of the species under review. This information is given in the Systematic part below (pp. 178–183). Of the slides in the Brady Collection attributed to *H. nanum*, several contain a further new species, not previously illustrated by



Figs 1-9 *Trochammina nana* (Brady). Figs 1-3, 6, Lectotype (ZF 3971); spiral, umbilical, oblique-umbilical and edge views. (Believed to be specimen illustrated by Brady, 1884, pl. 35, fig. 8), $\times 118$. Figs 4, 5, Paralectotype (ZF 3972); umbilical and spiral views in immersion oil, $\times 164$. Figs 7-9, Paralectotype (ZF 3973); spiral, umbilical and oblique-umbilical views, $\times 168$.

All from *Challenger* station 346, South Atlantic.

Brady, which is thought worthy of formal description. This is given the name *Trochammina pintoi* sp. nov. and is described from *Challenger* station 323, at 1,900 fathoms (3,480 m), in the S.W. Atlantic (B.M.N.H. slide no. 1958.3.13.801–808). It is illustrated in Figs 10–14, 17.

Systematics

The material illustrated in this paper is housed in the collections of the Protozoa Section, Department of Palaeontology, registration numbers ZF 3971–ZF 3984 inclusive.

Family: **TROCHAMMINIDAE** Schwager, 1877
Subfamily: **TROCHAMMININAE** Schwager, 1877

Genus: **TROCHAMMINA** Parker & Jones, 1859

Type species: *Nautilus inflatus* Montagu, 1808.

Trochammina nana (Brady)

1881 *Haplophragmium nanum* Brady: 50.

1884 *Haplophragmium nanum* Brady; Brady: 311 (*pars*), pl. 35, figs 7, 8 only.

1960 *Trochammina nana* (Brady) Barker: 72 (*pars*), pl. 35, figs 7, 8 only [after Brady, 1884].

MATERIAL. 6 syntypes, B.M.N.H. slide no. ZF 1547, plus 2 further specimens from the type locality in the Heron-Allen & Earland Collection, ex Sidebottom 'Challenger type-slide Collection', C12, square 6.

LECTOTYPE. B.M.N.H. ZF 3971, ex slide no. ZF 1547, *Challenger* station 346, north of Ascension Island, South Atlantic, lat. 2°42'S, long. 14°41'W, depth 2,350 fathoms (4,300 m). Believed to be the specimen figured by Brady, 1884, pl. 35, fig. 8. Refigured in Figs 1–3, 6, by scanning electron microscopy.

DESCRIPTION (LECTOTYPE). Test a loosely coiled trochospire, subcircular in umbilical and spiral views and strongly lobulate. In edge view, convex spirally, concave umbilically, well rounded at the periphery. Proloculus very large, followed by 9 subglobular chambers arranged in almost two whorls and increasing only slowly in size; 6 chambers in final whorl. Radial sutures deeply incised, straight to slightly curved. Umbilicus deep and open. Aperture an interiomarginal extra-umbilical arch with lip, without direct communication to the umbilical depression; because of loose coiling, apertures of the penultimate and antepenultimate chambers incompletely covered by the subsequent chambers and partially open. Wall agglutinated, single layered, imperforate and thin (5 µm). Agglutinant, very fine, consisting of quartz flakes and spicules of siliceous sponges. Colour light yellow-brown, except for the colourless final chamber.

DIMENSIONS (LECTOTYPE). Maximum diameter 410 µm, minimum diameter 340 µm, maximum width 200 µm. Maximum external proloculus diameter 120 µm. Diameter of umbilical depression 100 µm. Length of apertural opening 70 µm.

VARIATION (PARALECTOTYPES). The 5 paralectotypes from slide ZF 1547 are morphologically similar to the lectotype. The megalospheric specimen illustrated in Figs 7–9 (ZF 3973) is smaller with a test diameter of between 230 and 290 µm. The single microspheric individual (unfigured) has 17 chambers arranged in just over 2 whorls with 8 chambers in the final whorl; the test diameter ranges between 320 and 440 µm and the proloculus is 20 µm across at its widest point. Specimen ZF 3972 (Figs 4, 5) has a test diameter of between 240 and 290 µm and a large megalospheric proloculus of 90 µm maximum diameter. A fragment of a further paralectotype, placed in dilute HCl did not break down but turned colourless; the test is very slightly calcareous.

The 'Challenger type-slide Collection' was originated by H. Sidebottom to illustrate examples of the species figured by Brady (1884) and was picked from topotypic material.

Sidebottom's specimens of *Trochammina nana* comprise a microspheric individual with a maximum diameter of 470 μm and 9 chambers in the last whorl and a megalospheric individual almost identical in size and morphology to the lectotype.

REMARKS. As all the specimens of *T. nana* s.s. examined exhibit the same overall test morphology, it is difficult to see why Brady thought them to represent aberrant specimens. In fact they seem to form a well defined taxon without close relatives within *Trochammina*.

The other specimen figured by Brady (1884, pl. 35, fig. 7) is dextrally coiled and cannot be recognized amongst the remaining syntypes nor in Sidebottom's *Challenger* type-slide.

DISTRIBUTION. Known only from the type locality. Recent.

Trochammina pintoi sp. nov.

Figs 10–14, 17.

?1881 *Haplophragmium nanum* Brady: 50 (?pars).

1884 *Haplophragmium nanum* Brady; Brady: 311 (pars), not illustrated.

DIAGNOSIS. A tightly coiled, 6–7 chambered, moderately inflated *Trochammina*, with a flat spiral side and broadly rounded at the periphery.

NAME. In honour of Dr Jrajá Damiani Pinto, of Porto Alegre, Brazil, for his contribution to the study of the microfauna, in particularly the Ostracoda, of the Brazilian Shelf.

MATERIAL. 8 specimens, B.M.N.H. slide no. 1958.3.13.801–808 plus 3 further specimens from the type-locality in the Heron-Allen & Earland 'Students' Collection'.

HOLOTYPE. B.M.N.H. ZF 3974, ex slide no. 1958.3.13.801–808, *Challenger* station 323, S.W. Atlantic (Argentine Basin), lat. 35°39'S, long. 50°47'W, depth 1,900 fathoms (3,480 m). Figured by scanning electron microscopy in Figs 12, 14, 17.

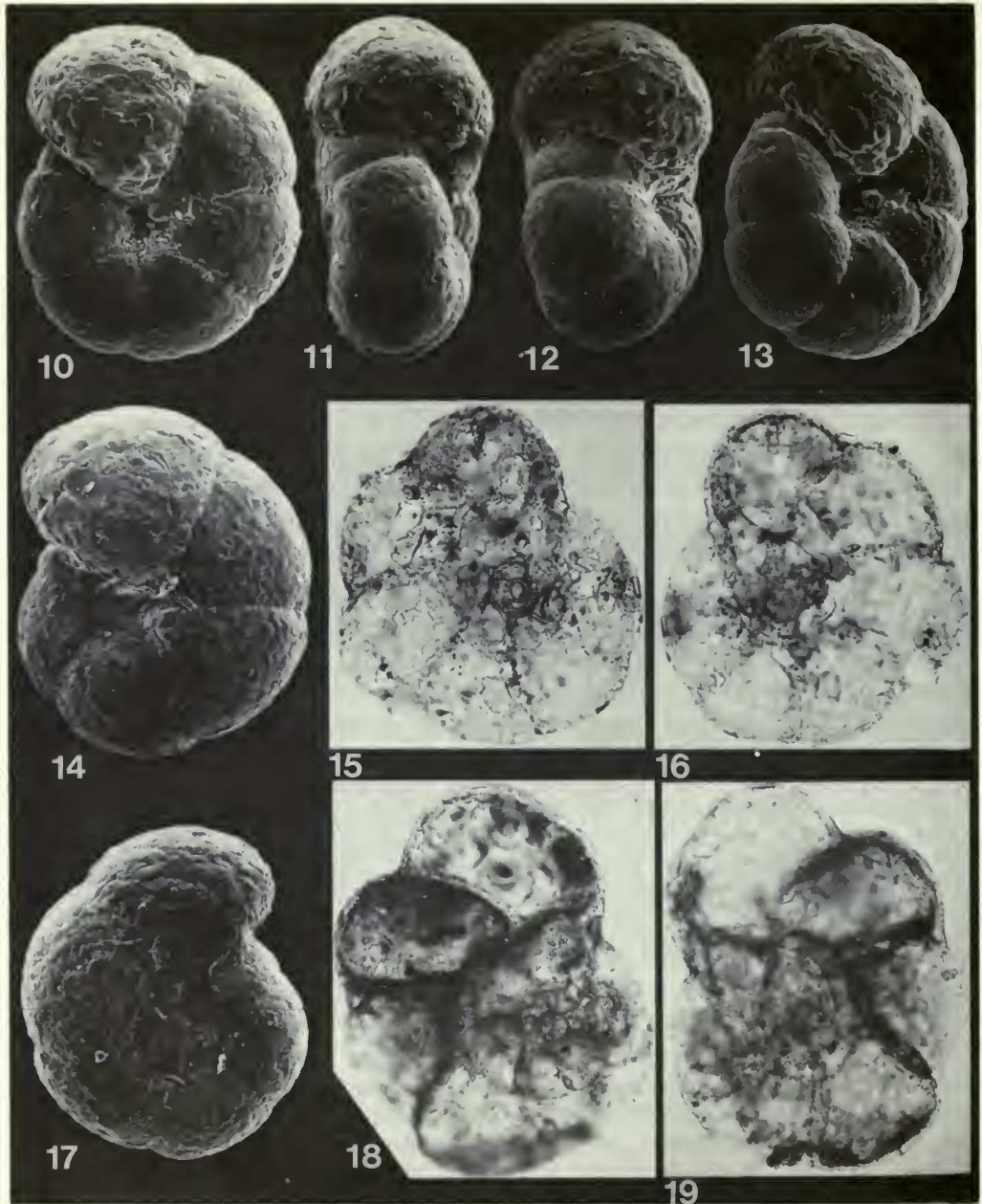
DESCRIPTION (HOLOTYPE). Test a trochospire of just over two whorls, moderately inflated but tightly coiled. Subcircular and virtually non-lobulate in umbilical and spiral views. In edge view, spirally flat, umbilically convex, broadly rounded at the periphery. Chambers inflated, closely embracing, 6 in final whorl, increasing only slowly in height and width; seen umbilically and spirally chambers sub-triangular in shape. On spiral side, early whorls form a slightly sunken area due to the overlap along the spiral suture of the chambers in the final whorl. Radial sutures straight, flush on spiral side, slightly depressed on umbilical side. Umbilicus tight. Aperture, a narrow umbilical peripheral slit without a lip, apparently separated from the umbilical depression and thus of *Trochammina*-type. Wall rather thick, agglutinated, single layered and imperforate, made up of quartz grains. Colour uniformly light brown-yellow.

DIMENSIONS (HOLOTYPE). Maximum diameter 350 μm , minimum diameter 310 μm , maximum width 220 μm .

VARIATION (PARATYPES). All the paratypes have a morphology very close to that of the holotype. The paratype (ZF 3975) illustrated in Figs 10, 11, 13, has 7 chambers in the final whorl, and about 21 chambers, including the proloculus, in all (the exact number of chambers and whorls cannot be determined). The maximum and minimum diameter of the test is 350 and 300 μm respectively, the greatest width 200 μm . The maximum diameter of the remaining paratypes ranges from 300 to 450 μm .

REMARKS. *Trochammina rossensis* Warthin from the Ross Sea, Antarctica (Warthin, 1934: 3, text-figs 1–3), shows similarities to our new species. In edge view, although the spiral side is also very flat the periphery of Warthin's species is sub-acute; moreover, it has the well developed umbilical flaps and aperture-type of a *Portatrochammina* (see below).

We have included, somewhat tentatively, the original reference to *H. nanum* (i.e. Brady, 1881) at least in part, in our synonymy of *T. pintoi*. This is because our new species comes from a South Atlantic *Challenger* station, as does the true *T. nana*, even though the



Figs 10–14, 17 *Trochammina pintoi* Brönnimann & Whittaker sp. nov. Figs 12, 14, 17, Holotype (ZF 3974); edge, umbilical and spiral views: figs 12, 17, $\times 132$; fig. 14, $\times 135$. Figs 10, 11, 13, Paratype (ZF 3975); umbilical, edge and oblique-umbilical views, $\times 132$. Both from *Challenger* station 323, S. Atlantic.

Figs 15, 16, 18, 19 *Portatrochammina bipolaris* Brönnimann & Whittaker sp. nov. Figs 15, 16, Paratype (ZF 3976); spiral and umbilical views in immersion oil, $\times 178$. Figs 18, 19, Paratype (ZF 3977); spiral and umbilical views in immersion oil, $\times 200$. Both from the Beaufort Sea (N.W. Canada), Arctic Ocean.

type-description of the latter does not seem to allow for its morphology, nor is it illustrated by Brady in any of his subsequent papers. It is more likely, however, that only later, in collating the data for his *Challenger* Report (1884), did Brady decide to include this form (the type-locality of *T. pintoi* is listed under the distribution of *H. nanum*: Brady, 1884, p. 312) within his wide concept of that taxon.

DISTRIBUTION. Known only from the type-locality. Recent.

Genus: **PORTATROCHAMMINA** Echols, 1971

Type species. *Portatrochammina eltaninae* Echols, 1971

***Portatrochammina bipolaris* sp. nov.**

Figs 15, 16, 18, 19–31.

1881a *Haplophragmium nanum* Brady; Brady: 406, pl. 21, figs 1a–c (*non H. nanum* Brady, 1881).

1882 *Haplophragmium nanum* Brady; Brady: 99, pl. 2, figs 1a–c.

1884 *Haplophragmium nanum* Brady; Brady: 311 (*pars*), pl. 35, figs 6a–c only.

1894 *Haplophragmium nanum* Brady; Goës: 22 (*pars*), pl. 5, figs 124–126 only.

1920 *Trochammina nana* (Brady) Cushman: 7, pl. 1, fig. 4.

1920a *Trochammina nana* (Brady); Cushman: 80, pl. 17, fig. 1 [after Brady, 1884, pl. 35, figs 6a–c].

?1931 *Trochammina nana* (Brady); Wiesner: 112, pl. 17, fig. 202.

?1948 *Trochammina nana* (Brady); Cushman: 42, pl. 5, figs 1a–c.

1952 *Trochammina nana* (Brady); Phleger: 86, pl. 13, figs 31, 32.

1953 *Trochammina nana* (Brady); Loeblich & Tappan: 50, pl. 8, fig. 5.

1960 *Trochammina nana* (Brady); Jarke: 619, pl. 4, figs 10a, b.

1960 *Trochammina nana* (Brady); Barker: 72 (*pars*), pl. 35, figs 6a–c only [after Brady, 1884].

1969 *Trochammina nana* (Brady); Vilks: 45, pl. 1, figs 23a, b.

1971 *Portatrochammina wiesneri* (Parr); Echols: 166 (*pars*), pl. 7, figs 2a–c (?1a–c) only (*non Trochammina wiesneri* Parr, 1950).

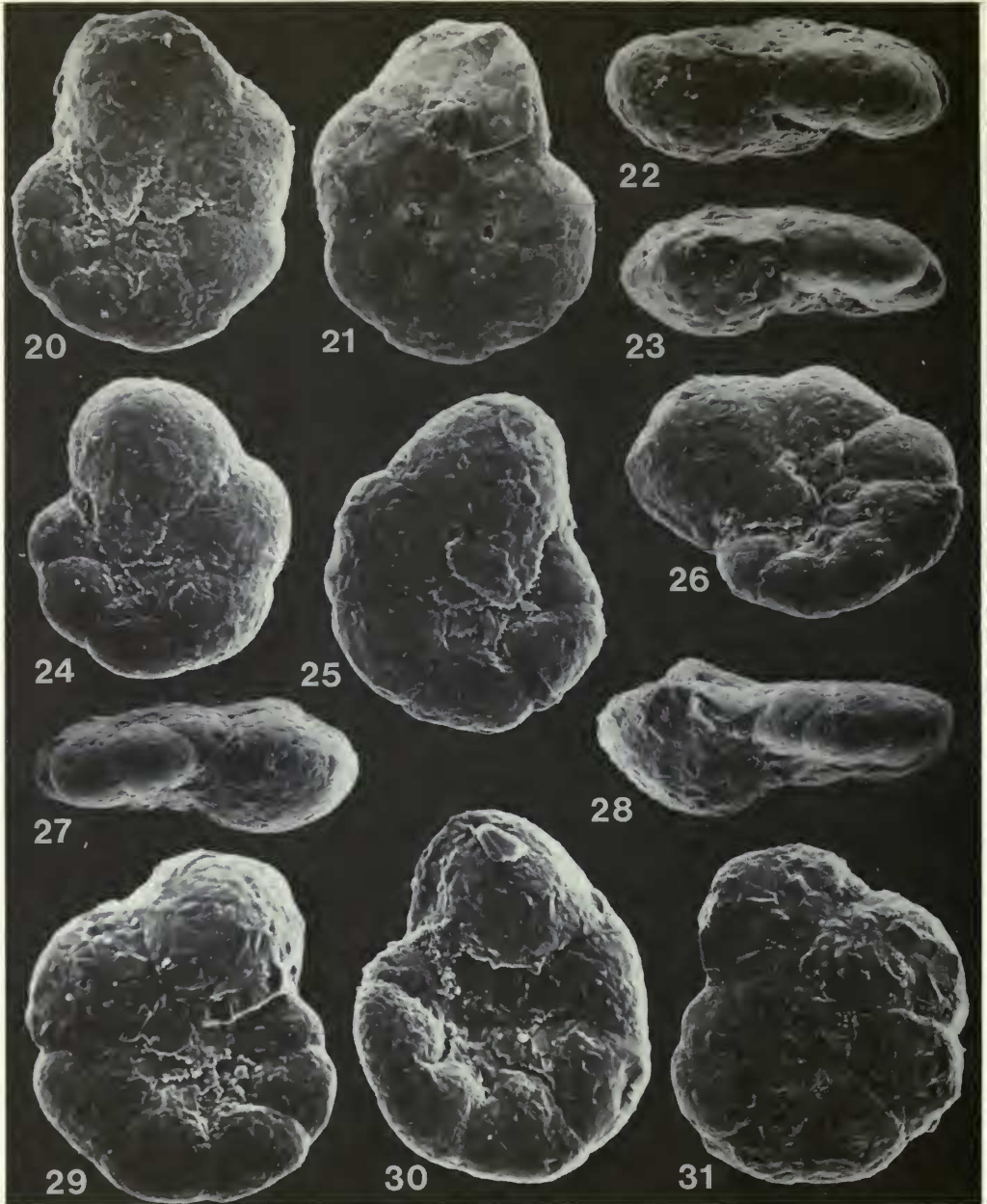
DIAGNOSIS. A small compressed *Portatrochammina* with 6–8 chambers in the final whorl. Edge view with diagnostic flat or only slightly convex spiral side. Last formed chambers increasing rapidly in size and quite lobulate. Umbilical area wide but shallow and covered by a series of well developed overlapping flaps.

NAME. Alludes to the bi-Polar distribution of this species.

MATERIAL. Over one hundred specimens from various Austro–Hungarian North Polar Expedition stations to the south of Franz-Josef Land, and about 40 specimens from the vicinity of the South Shetlands and Graham Land, Antarctica (material from *Discovery* and *Terra Nova* Expeditions), both in the Museum Collections; several specimens from the Beaufort Sea, N.W. Canada, donated by Drs Schafer & Vilks.

HOLOTYPE. B.M.N.H. ZF 3979, selected from about 40 specimens in slide no. ZF 1546, Austro–Hungarian North Polar Expedition station 518, off Franz-Josef Land, Arctic Ocean, depth 113 fathoms (207 m). The slide is labelled as containing specimen(s) figured by Brady, 1881a, pl. 21, figs 1a–c and Brady 1884, p. 35, figs 6a–c, but actual specimen(s) cannot be recognized. Figured by scanning electron microscopy in Figs 20, 21, 26.

DESCRIPTION (HOLOTYPE). Test a low trochospire; elongate-ovate in outline in umbilical and spiral views, final portion somewhat lobulate. In edge-view, compressed, almost flat spirally, concave umbilically and rounded to sub-acute peripherally; final chamber characteristically flat on the spiral side and strongly convex on the umbilical side. Chambers about 14 in number, radially elongate and tangentially short; 7 in the final whorl, overlapping at the umbilical ends along the radial sutures; later formed chambers increasing rapidly in size. Radial sutures straight to sinuous on the umbilical side and slightly curved on the spiral side. Shallow umbilical depression covered by the partially overlapping free umbilical flaps of the chambers of the final whorl, typical of a *Portatrochammina*. Aperture begins as a low interiomarginal opening near the periphery extending as a slit around the umbilical flap; last



Figs 20–31 *Portatrochammina bipolaris* Brönnimann & Whittaker sp. nov. Figs 20, 21, 26, Holotype (ZF 3979); umbilical, spiral and oblique-umbilical views, $\times 176$. Figs 22, 25, Paratype (ZF 3980); edge and umbilical views, $\times 200$. Figs 23, 29, 31, Paratype (ZF 3981); edge, umbilical and spiral views: fig. 23, $\times 172$; figs 29, 31 $\times 180$. Figs 24, 27, Paratype (ZF 3982); umbilical and edge views, $\times 168$ and $\times 182$ respectively. Fig. 28, Paratype (ZF 3983); edge view, $\times 152$. Fig. 30, Paratype (ZF 3984); oblique-umbilical view, $\times 250$.

Figs 20, 21, 24, 26, 27, from Austro-Hungarian North Polar Expedition, station 518, off Franz-Josef Land (U.S.S.R.), Arctic Ocean (between lats. 79° and 80°N). Fig. 28, from Austro-Hungarian North Polar Expedition, station 516, off Franz-Josef Land, depth 130 fathoms (238 m), ex Brit. Mus. Nat. Hist. slide no. 1955.10.1.312–345. Figs 22, 25, from *Discovery* station 177, off South Shetland Islands, Antarctica (lat. $63^{\circ}18'\text{S}$, long. $60^{\circ}20'\text{W}$), depth 1,080 m, ex Heron-Allen & Earland 'type-slide' no. 697, square 54. Figs 23, 29–31, from the Beaufort Sea (N.W. Canada) Arctic Ocean (north of lat. 70°N).

formed aperture, as well as preceeding apertures being in direct communication with the umbilical depression and presumably all functional. Wall agglutinated, single layed and imperforate, consisting of very fine quartz elements interspersed locally with irregular shaped, larger grains. Colour of early portion of test dark brown, grading into lighter brown, final chamber virtually colourless.

DIMENSIONS (HOLOTYPE). Maximum diameter 270 μm , minimum diameter 200 μm , width 70 μm . Proloculus diameter 10 μm .

VARIATION (PARATYPE). Figs 22–25, 27–31, show both six and seven chambered forms and illustrates the variation in morphology in spiral, umbilical and edge views. Particularly variable is the chamber shape and lobulation of the final portion of the test and the length of the free portion of the umbilical flap of the last-formed chamber; in some forms this flap can almost cover the earlier flaps (e.g. Fig. 24), in others it is short, so that the flaps of all the chambers in the final whorl are exposed (e.g. Fig. 29). The maximum diameter of the specimens examined in our study varied between 150 and 320 μm . The number of whorls varies between about $2\frac{1}{2}$ and 3.

Two specimens donated by Drs Schafer & Vilks (ZF 3976, ZF 3977) are illustrated in a clearing medium (Figs 15, 16, 18, 19). The proloculus can be clearly seen and in both cases has a diameter of about 20 μm . The wall of the final chamber is 2–3 μm thick. In dilute HCl, the tests do not disintegrate nor does the colour change; the wall is very slightly calcareous.

REMARKS. Unambiguous references to our new species, with good illustrations, are not common in the literature. In particular, no mention is made of the umbilical flaps in earlier papers nor can they be readily seen in many published figures; the most surprising example of this omission being Brady himself (1881a; 1884), whereas we know, from the type-material that the flaps exist. The vast majority of citations of *Haplophragmium nanum* or *Trochammina nana auctt.*, nevertheless, do not belong to any of the three species revised in this paper.

That the species should occur in both Polar seas and not elsewhere, is perhaps surprising, but the Antarctic form (see Figs 22, 25) would appear identical to that from the Arctic (Figs 20, 21, 23, 24, 26–31). The Antarctic specimens of *P. bipolaris* have been checked against the types of the species of Trochamminidae described by Parr (1950), and preserved in the South Australian Museum, Adelaide, and those of Heron-Allen & Earland (1922; 1932) and Earland (1933–36) in this institute, all from that region. None would appear to be synonymous with our new species.

A specimen of the type-species of *Portatrochammina*, *P. eltaninae* Echols, from the *Terra Nova* Expedition, station 194 (26), collected off Oates Land, Antarctica (lat. 69°43'S, long. 163°24'E), is illustrated in Figs 32–34, for comparison with *P. bipolaris*. It has been checked against the holotype of Echols's species (U.S. National Museum reg. no. 687210; figured in Echols, 1971, pl. 8, figs 1a–d). *P. eltaninae* is a five-chambered species and is less compressed and has more globose chambers than *P. bipolaris*; furthermore, the umbilical flap of the last-formed chamber almost completely covers the umbilicus.

DISTRIBUTION. Arctic Ocean – widespread in the Canadian Arctic (Cushman, 1920; Phleger, 1952; Vilks, 1969; Schafer & Vilks's material, herein); around Greenland (Phleger, 1952; Loeblich & Tappan, 1953); the Russian (Brady, 1881a; 1882; Jarke, 1960, and material herein) and Scandinavian Arctic (Goës, 1894; Jarke, 1960). Its most southerly substantiated record in the N. Hemisphere is from the Faroes Channel (slide marked 'cold area', *Porcupine* Expedition material, B.M.N.H.).

Antarctic – Scotia Sea (as *P. wiesneri* (Parr); Echols, 1971); off the South Shetlands and Graham Land (Heron-Allen & Earland, 1922; 1932, unfigured, but verified from their collections, see herein).

A Recent species only, as far as we are aware. Records exist back to the Cretaceous (e.g. Chapman, 1892: 6, pl. 5, figs 15a–c), but these are not conspecific. A shelf species, living down to about 1,000 m, but in Arctic waters commonly found between 150 and 300 m.



Figs 32–34 *Portatrochammina eltaninae* Echols. ZF 3978. Spiral, edge and umbilical views of same specimen, for comparison with *P. bipolaris*, $\times 142$.

From British Antarctic (*Terra Nova*) Expedition station 194 (26), off Oates Land, Antarctica, depth 180–200 fathoms (329–366 m) ex Heron-Allen & Earland 'type slide' no. 316, square 16.

Acknowledgements

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